PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-159640

(43)Date of publication of application : 16.06.1998

(51)Int.Cl. F02D 45/00
F02D 41/22
G01N 27/04

(21)Application number : 08-321563

(22)Date of filing : 02.12.1996

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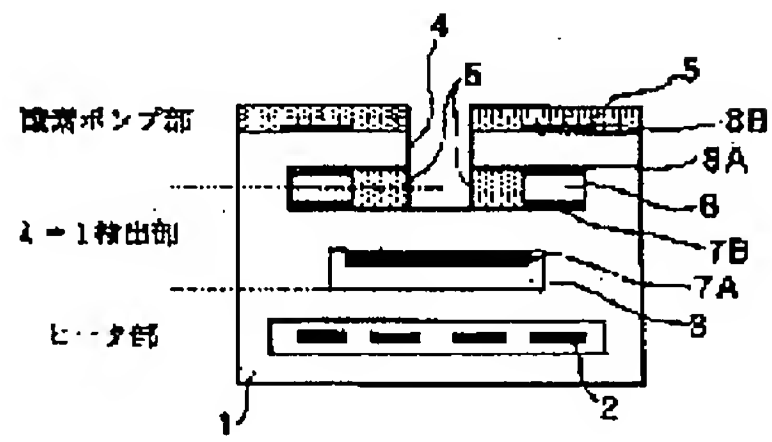
TOMIZAWA NAOMI

(54) DIAGNOSTIC DEVICE FOR ABNORMALITY OF AIR-FUEL RATIO SENSOR

(57)Abstract:

PROBLEM TO BE SOLVED: To accurately diagnose abnormality of a wide range air-fuel ratio sensor by diagnosing abnormality of the air-fuel ratio sensor based on the current value flowing between the electrodes of the air-fuel ratio sensor, when an abnormality diagnosis beginning condition including that an engine is operated at a fixed air-fuel ratio after starting the engine is judged to be realized.



SOLUTION: For diagnosing abnormality of a wide range air-fuel ratio sensor 1, when an abnormality diagnosis beginning condition in which a fixed time lapses after starting, activity of the air-fuel ratio sensor is judged, an air-fuel ratio feedback control condition is materialized, and the like, is realized, monitoring of the current value between oxygen pump electrode parts 8A, 8B is begun. Next it is judged whether the current value is within a fixed range or not, and in the case of YES, the air-fuel ratio sensor 1 is judged to be normal. Meanwhile, in case of 'NO', it is judged that some abnormality exists so as to pass NG judgement. When such NG judgements are continuously generated for example two times, a warning lamp is lighted so as to let a driver and the like recognize existence of some abnormality and urge him dealing such as repair.

LEGAL STATUS

[Date of request for examination]	07.07.2000
[Date of sending the examiner's decision of rejection]	15.07.2003
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

CLAIMS

[Claim(s)]
[Claim 1] It is based on the current value which flows this inter-electrode one when a predetermined electrical potential difference is impressed to inter-electrode [which was prepared on both sides of the gaseous diffusion layer faced and prepared in engine exhaust air]. A judgment means to judge whether the abnormality diagnostic start condition which is the abnormality diagnostic equipment of an air-fuel ratio sensor which detected the air-fuel ratio of engine exhaust air, and includes that the engine is operated with the predetermined air-fuel ratio after engine start up was satisfied, Abnormality diagnostic equipment of the air-fuel ratio sensor characterized by constituting including an abnormality diagnostic means to perform an abnormality diagnosis of an air-fuel ratio sensor based on said current value when judged with the abnormality diagnostic start condition having been satisfied.
[Claim 2] Abnormality diagnostic equipment of the air-fuel ratio sensor according to claim 1 characterized by said abnormality diagnostic start condition including having carried out after [engine start up] predetermined time progress.
[Claim 3] Abnormality diagnostic equipment of the air-fuel ratio sensor according to claim 1 or 2 characterized by said abnormality diagnostic start condition including that said air-fuel ratio sensor was activated.
[Claim 4] Abnormality diagnostic equipment of the air-fuel ratio sensor of any one publication of claim 1 characterized by including that said abnormality diagnostic start condition is during the feed back control of air-fuel ratio based on the detection value of said air-fuel ratio sensor - claim 3.
[Claim 5] Abnormality diagnostic equipment of the air-fuel ratio sensor of any one publication of claim 1 characterized by said abnormality diagnostic start condition including that the electrical potential difference of the power supply source for engine operation control is more than predetermined - claim 4.
[Claim 6] Abnormality diagnostic equipment of the air-fuel ratio sensor of any one publication of claim 1 - claim 5 by which said abnormality diagnostic means is characterized by performing an abnormality diagnosis of an air-fuel ratio sensor based on whether said current value is in predetermined within the limits.
[Claim 7] Abnormality diagnostic equipment of the air-fuel ratio sensor according to claim 6 by which said predetermined range is characterized by being changed according to a target air-fuel ratio.

[Translation done.]

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention] This invention relates to the equipment which performs an abnormality diagnosis of the so-called broader-based air-fuel ratio sensor.
[Description of the Prior Art] There is a thing as shown in drawing 2 as the so-called broader-based air-fuel ratio sensor from the former, for example. As shown in drawing 2 , this thing in the body (for example, formed by the heat-resistant porosity insulating material of the zirconia Zr 2O3 which has oxygen ion conductivity etc.) 1 equipped with the heater section 2 While forming atmospheric air (standard gas) and the atmospheric-air installation hole 3 open for free passage, the gas for detection (for example, an internal combustion engine's exhaust air etc.), the gas installation hole 4 for detection, and the gaseous diffusion layer (or gaseous diffusion gap) 6 that is open for free passage through protective layer 5 grade are formed. While the sensing section electrodes 7A and 7B are faced and formed in the atmospheric-air installation hole 3 and the gaseous diffusion layer 6, the oxygen-pumping electrodes 8A and 8B are formed in the gaseous diffusion layer 6 and the perimeter of the body 1 corresponding to this. In addition, the sensing section electrodes 7A and 7B (sensor section) detect the electrical potential difference generated according to the sensing section inter-electrode oxygen division ratio influenced with the oxygen ion concentration in the gaseous diffusion layer 6 (oxygen tension). On the other hand, a predetermined electrical potential difference is impressed to the oxygen-pumping electrodes 8A and 8B (specific component pump section). That is, the sensing section electrodes 7A and 7B can detect the electrical potential difference generated by the sensing section inter-electrode oxygen division ratio, and it can detect now whether an air-fuel ratio is rich to theoretical air fuel ratio (if it puts in another way excess air factor lambda= 1), or you are Lean. In the oxygen-pumping polar zone 8A and 8B which can be shown on the other hand in model drawing like drawing 3 , if a predetermined electrical potential difference is impressed, according to this, the oxygen ion in the gaseous diffusion layer 6 will be moved, and a current will flow between oxygen-pumping polar-zone 8A and 8B. In addition, since it is influenced by the oxygen ion concentration in the gaseous diffusion layer 6, if the current value (limiting current) Ip which flows this inter-electrode one when a predetermined electrical potential difference is impressed between oxygen-pumping polar-zone 8A and 8B detects a current value (limiting current) Ip, it can detect the air-fuel ratio (if it puts in another way the excess air factor lambda) of the gas for detection. Oxygen-pumping inter-electrode a current and an electrical potential difference as followed, for example, shown in the table A of drawing 3 , the air-fuel ratio (if it puts in another way the excess air factor lambda) of the gas for detection, and the correlation of ** will be acquired. In addition, based on the Rich Lean output of the sensing section electrodes 7A and 7B, detection of a wide range air-fuel ratio based on the current value (limiting current) Ip which flows between oxygen-pumping polar-zone 8A and 8B in the air-fuel ratio field of both the Lean field and a rich field by reversing the impression direction of the electrical potential difference to the oxygen-pumping polar zone 8A and 8B is enabled. If the current value Ip between oxygen-pumping polar zone is detected, for example, the table B of drawing 3 is referred to by the above air-fuel ratio detection principles, it will continue broadly and the actual air-fuel ratio (excess air factor lambda) of the gas for detection can be detected. In addition, the sensor appearance value Ip can also be calculated for example, by the degree type.
Ip=Do2**P**S/(T-L), ln {1/(1-Po2/P)}

Do2: -- diffusion coefficient S: of the porous layer of oxygen gas -- electrode surface product L: of cathode -- thickness P:total pressure Po2:oxygen tension T: of a porous layer -- temperature [the technical problem which invention tends to solve] however, a ****** [that the so-called above broader-based air-fuel ratio sensors can be operating normally] -- or a possibility of a broader-based air-fuel ratio sensor not understanding whether the air-fuel ratio being correctly detectable, for example, causing trouble in an internal combustion engine's Air Fuel Ratio Control since the technique diagnosed about whether the engine performance having deteriorated was not established -- it is -- with -- **** -- there is a possibility that it may become impossible to maintain performance, the exhaust air engine performance, the fuel consumption engine performance, etc. good. This invention was made in view of this conventional actual condition, is a comparatively easy configuration and aims at offering the abnormality diagnostic equipment of an air-fuel ratio sensor which can diagnose whether the broader-based air-fuel ratio sensor can be operating normally to high degree of accuracy.

[Means for Solving the Problem] For this reason, the abnormality diagnostic equipment of the air-fuel ratio sensor concerning invention according to claim 1 It is based on the current value which flows this inter-electrode one when a predetermined electrical potential difference is impressed to inter-electrode [which was prepared on both sides of the gaseous diffusion layer faced and prepared in engine exhaust air], as shown in drawing 1 . A judgment means to judge whether the abnormality diagnostic start condition which is the abnormality diagnostic equipment of an air-fuel ratio sensor which detected the air-fuel ratio of engine exhaust air, and includes that the engine is operated with the predetermined air-fuel ratio after engine start up was satisfied, When judged with the abnormality diagnostic start condition having been satisfied, it constituted including an abnormality diagnostic means to perform an abnormality diagnosis of an air-fuel ratio sensor based on said current value. Since according to this configuration an abnormality diagnosis of an air-fuel ratio sensor performs based on comparing with a actual current value the current value which will be acquired (for example, when it becomes the bottom of the condition from which an engine is operated with a predetermined air-fuel ratio) etc., for example when an abnormality diagnostic start condition is satisfied after engine start up, it becomes possible to diagnose the existence of the abnormalities of the broader-based air-fuel ratio sensor which was not made conventionally with a comparatively easy configuration. It was made for said abnormality diagnostic start condition to include having carried out after [engine start up] predetermined time progress in invention according to claim 2. Since according to this configuration the unstable state of said current value immediately after engine start up can be avoided and an abnormality diagnosis of an air-fuel ratio sensor can be performed, improvement in abnormality accuracy can be aimed at. It was made for said abnormality diagnostic start condition to include that said air-fuel ratio sensor was activated in invention according to claim 3. Since according to this configuration the unstable state of said current value in the inactive condition of said air-fuel ratio sensor can be avoided and an abnormality diagnosis of an air-fuel ratio sensor can be performed, improvement in abnormality accuracy can be aimed at. It was made for said abnormality diagnostic start condition to include that it is during the feed back control of air-fuel ratio based on the detection value of said air-fuel ratio sensor in invention according to claim 4. Since it is in the condition that tended to carry out control maintenance of the exhaust air air-fuel ratio at the predetermined value, and the exhaust air air-fuel ratio was stabilized comparatively, during the feed back control of air-fuel ratio based on the detection value of said air-fuel ratio sensor, said current value must also be comparatively stable. Therefore, if the current value which will originally be acquired under this situation is compared with the current value detected actually, the existence of the abnormalities of an air-fuel ratio sensor can be diagnosed to high degree of accuracy. It was made for said abnormality diagnostic start condition to include that the electrical potential difference of the power supply source for engine operation control is more than predetermined in invention according to claim 5. According to this configuration, if the supply power source of the power supply source for engine operation control falls, since the air-fuel ratio of engine exhaust air is no longer controlled normally or becomes unstable [said current value], in the abnormality diagnosis based on said current value, ****** which causes an incorrect diagnosis will become high, but such **** can be eliminated certainly. Based on whether said current value is in predetermined within the limits, said abnormality

diagnostic means consisted of invention according to claim 6 so that an abnormality diagnosis of an air-fuel ratio sensor might be performed. Thus, if constituted, an abnormality diagnosis of an air-fuel ratio sensor can be carried out to high degree of accuracy with a comparatively easy configuration. Said predetermined range consisted of invention according to claim 7 so that it might be changed according to a target air-fuel ratio. Since according to this configuration said predetermined range which is the judgment level of an abnormality diagnosis can be changed according to it even if an engine's target air-fuel ratio changes with change of operational status etc. (irrespective of feedback control and feedforward control), an abnormality diagnosis of an air-fuel ratio sensor can be further carried out to high degree of accuracy.

[Embodiment of the Invention] Below, 1 operation gestalt of this invention is explained based on an attached drawing. With this operation gestalt, when detecting an internal combustion engine's exhaust air air-fuel ratio, it will explain on behalf of the abnormality diagnostic approach of the broader-based air-fuel ratio sensor at the time of applying a broader-based air-fuel ratio sensor. In drawing 4 which shows the whole 1 operation gestalt configuration of this invention, the throttle valve 14 which is interlocked with the air flow meter 13 and accelerator pedal which detect inhalation air flow Q a at an engine's 11 inhalation-of-air path 12, and controls inhalation air flow Q a is formed, and the electromagnetic fuel injection valve 15 is formed in a down-stream manifold part for every cylinder. A fuel injection valve 15 carries out injection supply of the fuel which carried out valve-opening actuation with the driving pulse signal set up in a control unit 50 as mentions later, was fed from the fuel pump which is not illustrated, and was controlled by the pressure regulator (not shown) by the predetermined pressure. Furthermore, the coolant temperature sensor 16 which detects the circulating water temperature Tw in an engine's 11 cooling jacket is formed. on the other hand -- a flueway 17 -- the near manifold set section -- the oxygen density under exhaust air -- being based -- inhalation -- the broader-based air-fuel ratio sensor 18 (it is equivalent to the broader-based air-fuel ratio sensor of this invention.) which detects the air-fuel ratio of gaseous mixture Hereafter, it is also only called an air-fuel ratio sensor. It is prepared, it sets to the downstream for example, near the theoretical air fuel ratio (lambda= 1, A/F(air weight / fuel weight) **14.7), and they are CO under exhaust air, and oxidation and NOX of HC. The three way component catalyst 19 as an exhaust air clarification catalyst which returns good and purifies exhaust air is infixed. In addition, as an exhaust air clarification catalyst, it is NOx, for example in the Lean (thin air-fuel ratio) field. So-called Lean NOx to return A catalyst may be adopted, and it does not matter even if it adopts a general oxidation catalyst. By the way, as long as the air-fuel ratio sensor 18 used in this operation gestalt uses the same detection principle as the same thing as usual shown by drawing 2 , it may be what kind of thing. Moreover, the crank angle sensor 20 is built in the distributor which does not illustrate by drawing 4 , and a fixed time amount count of the crank unit angle signal outputted from this crank angle sensor 20 synchronizing with an engine revolution is carried out in a control unit 50, or the period of a crank reference angle signal is measured, and the engine rotational speed Ne is detected. By the way, the control unit 50 concerning this invention consists of a microcomputer constituted including CPU, ROM, RAM, an A/D converter, an input/output interface, etc., receives the input signal from various sensors, and controls the injection quantity (namely, the amount of Air Fuel Ratio Control) of a fuel injection valve 15 as follows. As said various kinds of sensors, there are the 18 air flow meter above-mentioned air-fuel ratio sensor 13, a coolant temperature sensor 16, and crank angle sensor 20 grade. Namely, inhalation air flow Q a called for from the voltage signal from an air flow meter 13, While calculating basic fuel-injection pulse width (equivalent to fuel oil consumption) Tp=cxQa/Ne (c is a constant) from the engine rotational speed Ne called for from the signal from the crank angle sensor 20 Final effective fuel-injection pulse width Te=Tpx(1+Kw+Kas+ ...) x alpha+Ts is calculated with the water temperature correction factor Kw compulsorily amended to a rich side at the time of low water temperature, the loading correction factor Kas after start up and start up, the air-fuel ratio feedback correction factor alpha, etc. Ts is a part for electrical-potential-difference amendment. And this effective fuel-injection pulse width Te will be sent to said fuel injection valve 15 as a driving pulse signal, and injection supply of the fuel by which metering was carried out to the specified quantity will be carried out. a multiplier for the above-mentioned air-fuel ratio feedback correction factor alpha to amend gap from the target air-fuel ratio of the actual air-fuel ratio which the air-fuel ratio sensor 18 detects -- it is --

this -- being based -- a control unit 50 -- the basic fuel pulse width Tp -- amending -- the object for combustion -- feedback control of the air-fuel ratio of gaseous mixture will be carried out to a target air-fuel ratio (for example, theoretical air fuel ratio). Here, abnormality diagnostic control of the air-fuel ratio sensor performed by the control unit 50 in this operation gestalt is explained according to the flow chart shown in drawing 5 . The flow concerned is performed once for every start up. In addition, as shown below, the control unit 50 of this operation gestalt is equipped with the function as the judgment means concerning this invention, and an abnormality diagnostic means by software. Step (it is described as S by a diagram.) the following -- the same . In 1, it judges whether it is abnormality diagnostic start condition formation (decision). That is, for example, delay of the initiation of an abnormality diagnosis is carried out until the conditions of the following ** - ** are satisfied. For example, it judges [whether after / ** engine start Keown -> OFF (Key on->off) / fixed time amount progress was carried out, and] whether it is no (when putting in another way, was after [start up] predetermined time progress carried out?), and diagnostic initiation is permitted if it has not passed. For example, it is for preventing the incorrect diagnosis under the effect of loading and wall style formation, and the incorrect diagnosis by a diagnosis being performed to the bottom of the inactive condition of the air-fuel ratio sensor 18 at the time of start up etc.
** Judge whether it is air-fuel ratio sensor (A/F sensor) activity judging termination, and diagnostic initiation is permitted if it has not ended. It is for preventing the incorrect diagnosis by a diagnosis being performed to the bottom of the inactive condition of the air-fuel ratio sensor 18 etc.
** Judge whether it is feed-back-control-of-air-fuel-ratio (A/F control) condition formation, and diagnostic initiation is permitted if not materialized. It is for preventing lowering of the accuracy when not controlling the air-fuel ratio by feed back control of air-fuel ratio to predetermined desired value.
** It judges whether battery voltage is beyond a predetermined value, and diagnostic initiation will be permitted if it is not beyond a predetermined value. It is for preventing the incorrect diagnosis resulting from lowering of battery voltage. Since it will be forbidden in the unstable condition of the air-fuel ratio sensor 18 after start up that an abnormality diagnosis should be performed as shown in the timing diagram of drawing 6 if it does in this way, it becomes possible to prevent generating of an incorrect diagnosis as much as possible in an abnormality diagnosis of an air-fuel ratio sensor. At continuing step 2, the monitor of the current value Ip between oxygen-pumping polar-zone 8A and 8B is started. At step 3, it judges whether a current value Ip is in predetermined within the limits as shown in drawing 6 . If it is YES, it will progress to step 4, and if it is NO, it will progress to step 5. That is, since the actual air-fuel ratio should be controlled so that a predetermined target air-fuel ratio is obtained if the air-fuel ratio sensor 18 is an active state and is during feed back control of air-fuel ratio, if the air-fuel ratio sensor 18 is normal, the current value Ip between oxygen-pumping polar-zone 8A and 8B should be converged on predetermined within the limits according to the air-fuel ratio. Therefore, supposing it is not being completed as predetermined within the limits by the current value Ip between oxygen-pumping polar-zone 8A and 8B, it can be judged that a possibility that a certain failure, degradation, etc. may have occurred in the air-fuel ratio sensor 18 is high. With this operation gestalt, the air-fuel ratio sensor 18 is diagnosed based on this view. At step 4, a current value Ip is in predetermined within the limits set up according to a target air-fuel ratio, judges that the air-fuel ratio sensor 18 is normal, carries out O.K. judging, and ends this flow. On the other hand, at step 5, there is no current value Ip in predetermined within the limits set up according to a target air-fuel ratio, it judges that there are a certain abnormalities (for example, {circuit failure of the oxygen-pumping section or the sensing section, an open circuit and short circuit of a harness, or degradation (the gaseous diffusion layer 6 and protective layer 5 grade are blinding etc.)}), and carries out NG judging. And when such an NG judging carries out continuation twice (two trips), for example and arises, the purport which progresses to step 6, and burning etc. carries out an alarm lamp (MIL), and has a certain abnormalities in the air-fuel ratio sensor 18 at an operator etc. is made to recognize, and the treatment of repair etc. is urged. Moreover, the feed back control of air-fuel ratio based on the detection result of the air-fuel ratio sensor 18 is forbidden in order to avoid aggravation of performance, the exhaust air engine performance, etc. as much as possible, and you may make it especially forbid the Lean combustion control etc. compulsorily. Thus, when continuation is carried out twice (two trips), were generated and it was made to make it progress to

step 6, and NG judging is carried out at the 1st time and O.K. judging is carried out at the time of the following trip, there is a possibility that 1st NG judging might be an incorrect judging, but since cannot put in such an incorrect judging and it can be carried out to consideration, the abnormality accuracy of the air-fuel ratio sensor 18 can be raised further. In addition, when count start up of predetermined is performed and NG judging is performed at a predetermined rate, the purport which burning etc. carries out an alarm lamp (MIL) and has a certain abnormalities to an operator etc. at the air-fuel ratio sensor 18 can be made to recognize. Moreover, of course, an alarm lamp (MIL) may be made to turn on for every NG judging. thus -- according to this operation gestalt -- after [engine start up] predetermined time progress -- carrying out -- under an engine revolution (operation) -- and since it was made to perform an abnormality diagnosis of an air-fuel ratio sensor based on whether it is being completed as predetermined within the limits by the current value Ip between oxygen-pumping polar-zone 8A and 8B when it was during the feed back control of air-fuel ratio (closing loop control) by the air-fuel ratio sensor 18, the existence of the abnormalities of an air-fuel ratio sensor can be diagnosed to quick and high degree of accuracy with an easy configuration. Therefore, since the feed back control of air-fuel ratio by the abnormal air-fuel ratio sensor will be eliminated at an early stage, it becomes possible to prevent beforehand or promptly aggravation of performance, the exhaust air engine performance, the fuel consumption engine performance, etc. In addition, although the monitor time amount for judging whether it is being completed as predetermined within the limits by the current value Ip between oxygen-pumping polar-zone 8A and 8B is not restricted with the above-mentioned operation gestalt, it is good also as a configuration restricted to predetermined time. Moreover, when there is a switch of a target air-fuel ratio, when acceleration-and-deceleration operation is detected, you may make it forbid a diagnosis and the predetermined range for said O.K. and NG judging can be changed according to a switch of a target air-fuel ratio, or change of operational status. By the way, although explained as what performs an abnormality diagnosis where feed back control of air-fuel ratio is started in this operation gestalt [when feedforward control is carried out not only to this but to for example, the predetermined target air-fuel ratio after start up] When the current value Ip between oxygen-pumping polar-zone 8A and 8B is large and small more than predetermined Since **** which abnormalities have generated is also in an air-fuel ratio sensor, an abnormality diagnosis of an air-fuel ratio sensor can be performed using the view of the abnormality diagnosis which requires feed back control of air-fuel ratio for this invention also in the condition of not being started yet. That is, an example considers that all of above-mentioned diagnostic start condition **s - **s were materialized as formation of a diagnostic start condition, and when either these **s or - the **s, and the thing combined suitably are materialized, it can consider as formation of a diagnostic start condition. In addition, since it is improvement in the detection precision of an air-fuel ratio, and a thing for amplification of the air-fuel ratio detection range, the heater section 2 and the sensing section electrodes 7A and 7B can apply this invention also in the air-fuel ratio sensor which is not equipped with these.

[Effect of the Invention] The inter-electrode current value which was established on both sides of the gaseous diffusion layer which will be obtained when an abnormality diagnostic start condition is satisfied after engine start up, for example according to invention according to claim 1 as explained above, Since an abnormality diagnosis of an air-fuel ratio sensor can be performed based on comparing a actual current value etc., it becomes possible to diagnose the existence of the abnormalities of the broader-based air-fuel ratio sensor which was not made conventionally with a comparatively easy configuration. Since according to invention according to claim 2 the unstable state of said current value immediately after engine start up can be avoided and an abnormality diagnosis of an air-fuel ratio sensor can be performed, improvement in abnormality accuracy can be aimed at. Since according to invention according to claim 3 the unstable state of said current value in the inactive condition of said air-fuel ratio sensor can be avoided and an abnormality diagnosis of an air-fuel ratio sensor can be performed, improvement in abnormality accuracy can be aimed at. According to invention according to claim 4, during the feed back control of air-fuel ratio based on the detection value of said air-fuel ratio sensor Since it is in the condition that tended to carry out control maintenance of the exhaust air air-fuel ratio at the predetermined value, and the exhaust air air-fuel ratio was stabilized comparatively It uses saying that said current value is also comparatively stable, and since it was made to make an abnormality diagnosis perform based on the current value

which will originally be acquired under this situation, and the current value detected actually, the existence of the abnormalities of an air-fuel ratio sensor can be diagnosed to high degree of accuracy. According to invention according to claim 5, if the supply power source of the power supply source for engine operation control falls, since the air-fuel ratio of engine exhaust air is no longer controlled normally or becomes unstable [said current value], in the abnormality diagnosis based on said current value, **** which causes an incorrect diagnosis will become high, but such **** can be eliminated certainly. According to invention according to claim 6, an abnormality diagnosis of an air-fuel ratio sensor can be carried out to high degree of accuracy with a comparatively easy configuration. Since according to invention according to claim 7 said predetermined range which is the judgment level of an abnormality diagnosis can be changed according to it even if an engine's target air-fuel ratio changes with change of operational status etc. (irrespective of feed back control of air-fuel ratio and air-fuel ratio feedforward control), an abnormality diagnosis of an air-fuel ratio sensor can be further carried out to high degree of accuracy.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the configuration of this invention
[Drawing 2] Structural drawing of a broader-based air-fuel ratio sensor
[Drawing 3] Drawing for explaining the air-fuel ratio detection principle of a broader-based air-fuel ratio sensor
[Drawing 4] The whole 1 operation gestalt block diagram of this invention
[Drawing 5] The flow chart explaining abnormality diagnostic control of the air-fuel ratio sensor in an operation gestalt same as the above
[Drawing 6] The timing diagram which shows the predetermined range (HGOPL, HGOPH) which is the situation and judgment level of change of a current value Ip between oxygen-pumping polar zone

[Description of Notations]
1 Body of Air-fuel Ratio Sensor
2 Heater Section
3 Atmospheric-Air Installation Hole
4 Gas Installation Hole for Detection
5 Protective Layer
6 Gaseous Diffusion Layer (or Gaseous Diffusion Gap)
7A, 7B Sensing section electrode
8A, 8B Oxygen-pumping electrode
11 Internal Combustion Engine
13 Air Flow Meter
17 Flueway
18 Air-fuel Ratio Sensor
20 Crank Angle Sensor
50 Control Unit

[Translation done.]

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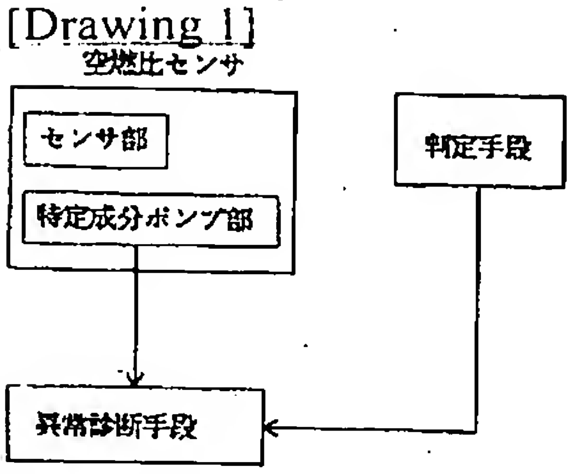
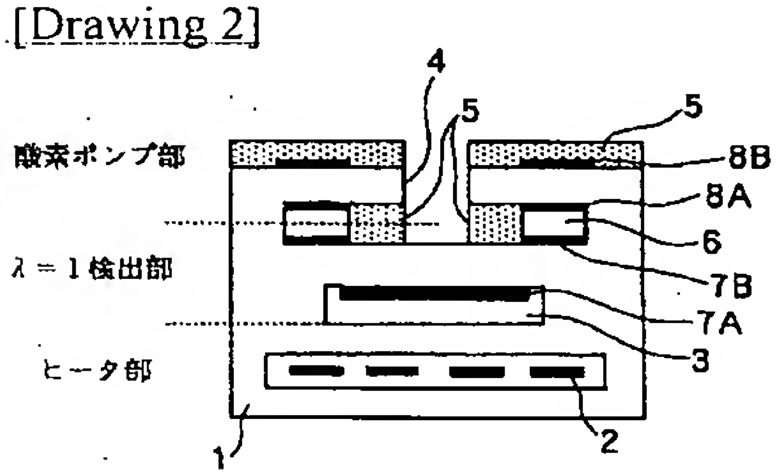
DRAWINGS

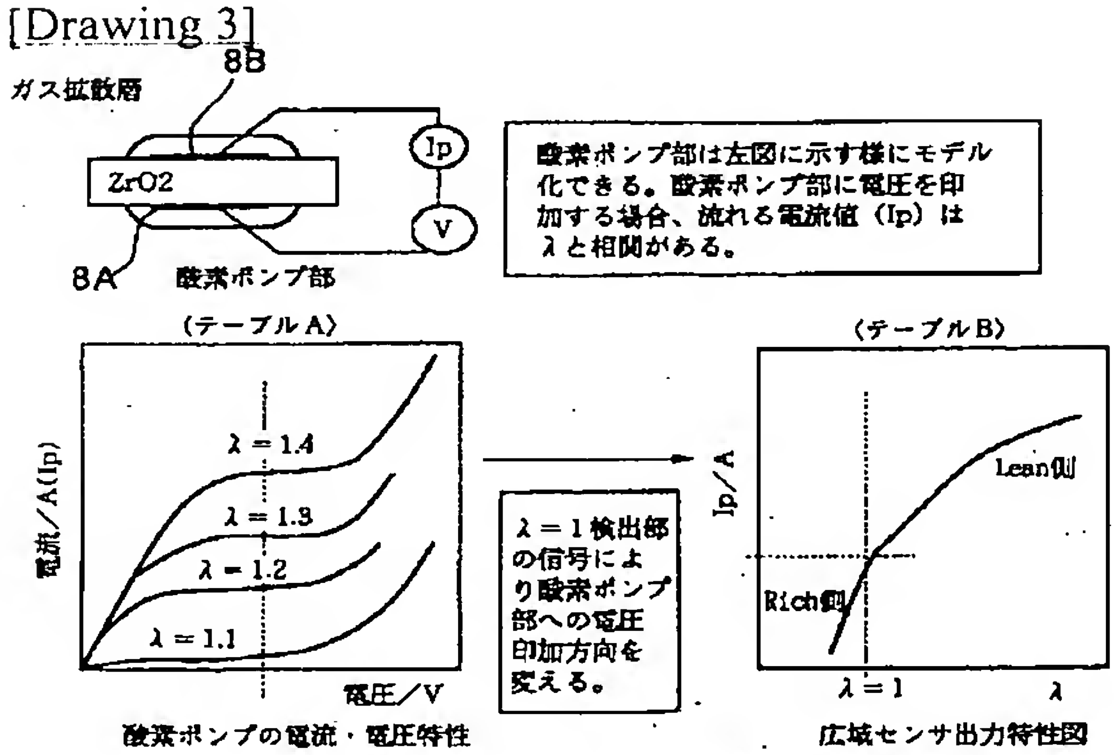
[Drawing 1]



[Drawing 2]



[Drawing 3]

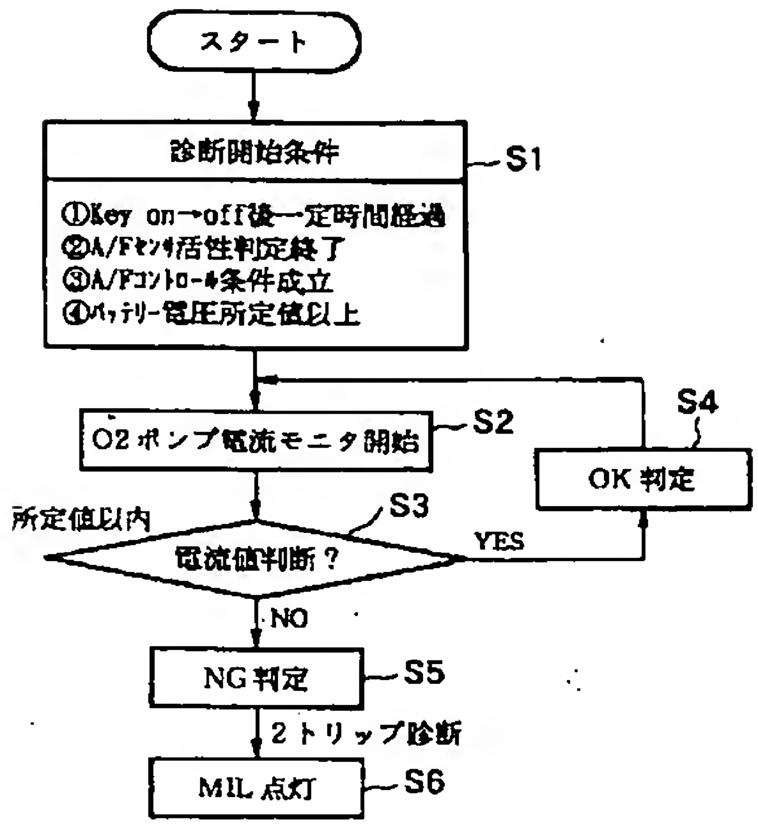


センサ出力

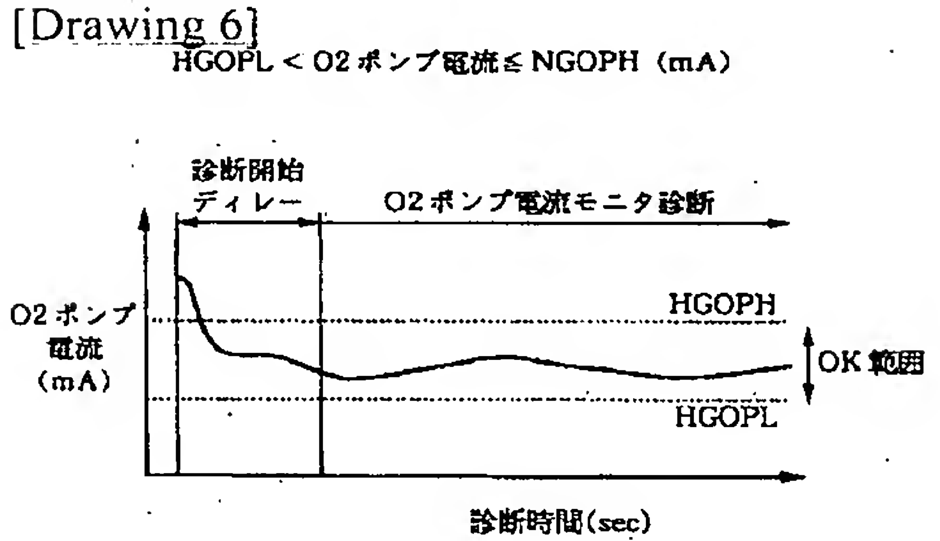
$$Ip = Do2 \frac{P \cdot S}{T \cdot L} \ln\left(\frac{1}{1 - Po2/P}\right)$$

Do2：酸素ガスの多孔質層の拡散係数
S ：陰極の電極面積
L ：多孔質層の厚さ
P ：全圧力
Po2：酸素分圧

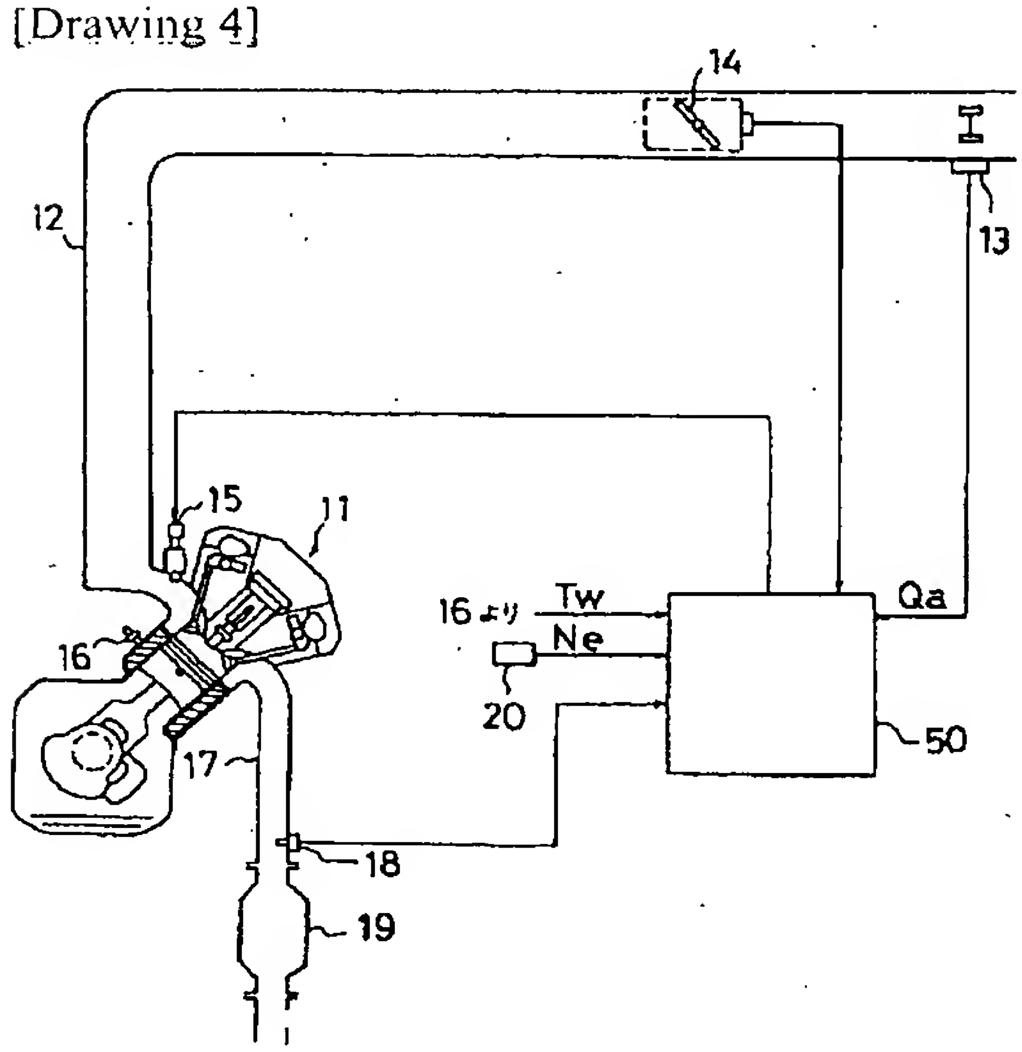
[Drawing 5]



[Drawing 6]



[Drawing 4]



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